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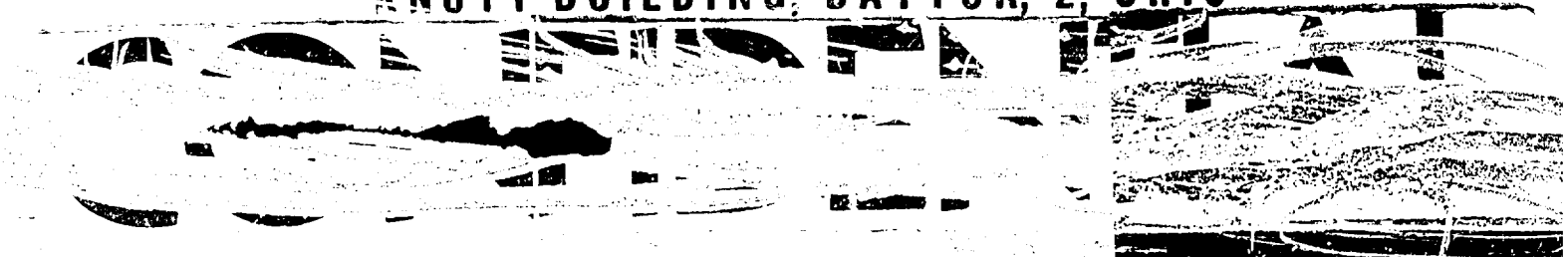

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TECHNICAL REPORT

MATERIAL LABORATORY

NEW YORK NAVAL SHIPYARD
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C O N F I D E N T I A L

RESEARCH AND DEVELOPMENT REPORT
on
CRITICAL THERMAL ENERGIES
of
ACETYLATED COTTON FABRIC
FOR USE IN CANOPY MATERIALS

Prepared by
THE SOUTHERN REGIONAL RESEARCH LABORATORIES
Lab. Project 5046-3, Part 68
Final Report 5 Nov. 1954 NS 081-001

Technical Objective AW-7
AFSWP-832

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C O N F I D E N T I A L

Lab. Project 5046-3, Part 68
Final Report

ABSTRACT

For the purpose of evaluating the resistance of materials to the thermal radiation of atomic explosions, the critical thermal energies of an acetylated cotton duck fabric, which was prepared by the Southern Regional Research Laboratories, U. S. Department of Agriculture, were determined. The fabric which was submitted by the Bureau of Ships, was evaluated by exposures to the Material Laboratory carbon-arc source of thermal radiation and by examining the consequent damage to the fabric. The damage was compared to that of the corresponding control, an untreated fabric. The methods of exposing the fabrics to determine their critical energies are indicated. It was found that both of the fabrics showed sporadic charring at 27 cal/cm^2 and destruction at 41 cal/cm^2. The acetylating treatment has no appreciable influence upon the resistance of the cotton fabric to the exposure to thermal radiation. As determined by a standard flammability test, the progation of flames is only moderately reduced by the acetylation process.

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ADMINISTRATIVE INFORMATION

1. This investigation was requested by Bureau of Ships confidential letter C-S90/1-5(348), Ser 348-068 dated 28 September 1954 and constitutes part of the program initially proposed by Commander, New York Naval Shipyard, confidential letter S99/L5, Ser 960-92, of 14 March 1950 and formally approved by Bureau of Ships speedletter S99(0)(348), Ser 348-75 of 6 April 1950. The general Thermal Radiation program at the Naval Material Laboratory is under the supervision of the Armed Forces Special Weapons Project.

2. This investigation was planned and executed under the direction of T. I. Monahan, Supervisor of the Optics Section.

INTRODUCTION

3. As part of its general program on the effects of the thermal radiation of atomic explosions, the Naval Material Laboratory is evaluating the characteristics, under exposure to intense thermal radiation, of the various materials of particular interest to the several agencies of the Department of Defense. As data become available, these findings are published. Reported below are the critical thermal energies of an acetylated cotton duck material, prepared by the Southern Regional Research Laboratories of the U. S. Department of Agriculture, New Orleans, Louisiana, and submitted by the Bureau of Ships Washington, D. C. Of particular interest is the increase in resistance to thermal radiation afforded by the acetylation process. A sample fabric, untreated, was submitted and evaluated as a control.

EQUIPMENT AND METHODS

4. The critical thermal energies of the fabrics were determined, employing the Naval Material carbon-arc source of thermal radiation. The source consists of an 11-mm carbon arc, mounted at the focus of a reflector which collimates the emitted energy. A second mirror, which is mounted coaxially at a distance of twelve feet from the collimator, condenses the radiation to the mirror's focus. Gradations of thermal damage are obtained by varying the effective exposure time by accelerating a 1x8-inch specimen transversely through the focus. The carbon arc furnishes an irradiance of 85 $cal/cm^2 sec$ over a central area 2mm in width. The exposure times varied from 0.3 to 0.6 seconds. For exposure to the carbon-arc radiation, the cotton specimens were mounted on glass melamine blocks which were provided with a cut-out to furnish an air background.

5. In order to determine the difference in flame propagation under standard conditions (without thermal radiation), a flammability test was conducted on the two duck fabrics, in accordance with Method 2022 of Federal Specification LP406b. In this test, a benzene drop was ignited on the edge of the material by means of a safety match and the time required to completely burn a 12-inch specimen was determined.

RESULTS

6. The critical thermal energies of the cotton duck fabrics were defined as those which produce certain characteristic, reproducible effects on the

materials, such as charring and destruction. The measured critical energies of the two fabrics are given in Table I.

7. It may be noted that both fabrics showed sporadic charring at approximately 27 cal/cm^2, but this charring was slightly more intense on the control specimen. There was, however, no appreciable difference between the two radiant exposure values and in the appearance of the destroyed cloths.

8. The flammability test showed that the untreated duck sample was consumed in 33 seconds and the acetylated specimens in 41 seconds. Repetition of the test confirmed these results.

CONCLUSIONS

9. The critical exposure values for sporadic charring and for destruction of the untreated and the acetylated cotton duck do not vary appreciably, and the acetylating process has only a negligible influence upon the thermal radiation resistance of the duck fabric.

10. Acetylating reduces the flame propagation of cotton duck only moderately.

Approved:

A. B. JONES, Jr., CAPTAIN, USN
The Director

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7. Naval Material Laboratory, A Method of Measuring High Intensities at the Focus of a Parabolic Reflector with Large Relative Aperture, Report No. 5046-3, Part 3 (November 1948).

Table I

Critical Thermal Energies
of
Canopy Materials
Submitted by
The Bureau of Ships

Material	Description of Effect	Critical Energy (cal/cm^2)
Cotton Duck, 8 oz. Acetylated, SRRL 979, 17% Acetyl.	Sporadic Charring Destroyed by afterflame	27 41
Cotton Duck, Untreated 8 oz. (Control)	Sporadic Charring Destroyed by afterflame	27 41

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1. Cotton textiles - effects of radiation
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